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WEED CONTROL AND
FIELD SERVICES
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Injurious Farm Weeds and their Control

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This Bulletin is a reprint of a number of pamphlets compiled in the years 1934 to 1936 by Dr. G. P. McRostie, P.H.D., Professor of Agronomy, University of Manitoba, and Mr. W. Tildesley, B.S.A., Assistant on Weed Research. Since publication of these pamphlets, Dr. McRostie has accepted a similar position at the Ontario Agricultural College, Guelph.

This survey was conducted under the direction of and financed by contributions from Members of the NORTH-WEST GRAIN DEALERS' ASSOCIATION, with the hope that it may be of some benefit to the farmers of Western Canada.

Farmers of Western Canada in Account with Farm Weeds

Date—Any Average Year.

60% of the cost of summerfallowing 7,000,000 acres	$31,500,000
Rent of 3,000,000 acres of land growing weeds	9,000,000
19% loss of yield due to weed competition in the fields	60,000,000
Cost of threshing 11,000,000 bus. of dockage	1,013,761
Average freight on dockage to Ft. William estimated at 13c per bus.	1,430,000
Cost of hauling 11,000,000 bus. dockage to elevator	165,000
Loss of feeding value estimated	550,000
40% of cultivation costs other than summerfallow	64,760,000
Loss of grades in oats and barley	1,257,546
Loss of grades in other crops than oats and barley	
Extra machinery for cleaning and upkeep of same	
Reduced value of forage crops and pasture	
Cattle poisoning	9,523,693
Special cleaning charges	
Extra labour, twine, etc., to harvest weeds	
Depression of Land values	
GRAND TOTAL	$179,200,000

What Weeds Cost Farmers In Western Canada

On Page 2 of this pamphlet is an itemized account of the cost of weeds to the farmers of Western Canada. It is our intention to analyze these items singly, by way of explanation, and to add a few points which are not quite so obvious, but inevitably charged back to the producer.

I wonder if any of our readers have ever tried to dry a crop of grain which was loaded with coarse, heavy weeds in a wet fall such as 1926 or 1927. Have they also counted the cost in terms of lowered grades, difficulty of threshing, grain going over in the straw pile, and in danger of heating in the bin due to small weeds? It would be interesting to know what it costs us for the privilege of growing ragweed, and just how much grain is rendered unfit for milling because it contains seed of this weed or of other weeds which cannot be removed by ordinary methods, but which render the grain useless for the manufacture of flour. Milling companies have hundreds of thousands of dollars invested in cleaning machinery, just to remove small weeds, wild oats and mustard. Terminal elevators have approximately $5,000,000 invested in cleaning equipment and large sums have been spent in placing cleaning machinery in country elevators in Western Canada.

INCREASED COST OF SUMMERFALLOWING

The question of how much of the annual cost of summerfallow should be charged against weed control will bear a little inspection. From experiments conducted in the semi-arid parts of Canada and the United States it would appear that the only benefit obtained from cultivating summerfallow is the conservation of moisture from one year to the next. In the absence of weeds it appears to be definitely established that the benefit obtained from the cultivation of summerfallow is not profitable. In other words a field left uncultivated may contain almost as much moisture as a cultivated field if no weeds are allowed to grow. For this reason it seems fair to charge 90 per cent of the summerfallow cost to weed control and 10 per cent to the preparation of a seed bed. In fact there are a few parts of the West where the conservation of moisture is a drawback and in such localities the whole cost of summerfallow should be charged to weed control.

Between these two extremes is a large area where the moisture in the lower soil levels needs building up after a period of years. The growth of weeds uses up the moisture, necessitating more frequent summerfallowing than otherwise would be the case.

Taken over the whole of the prairie provinces, 60 per cent is a very fair proportion of the summerfallow cost to charge against weeds.

LOSS OF RETURN FROM LAND UNDER FALLOW

Disregarding those areas of southern Alberta, Saskatchewan and southwestern Manitoba, which require to be kept fallow to conserve moisture, we can safely say that in the remainder of the West the frequency of summerfallow has been increased 50% due to excessive increase in weeds. Therefore approximately 3,000,000 acres are being summerfallowed each year, which would otherwise be producing grain. Assuming a low rental value of $3.00 per acre for this land, the annual loss due to it not producing a crop would be at least $9,000,000.

19% LOSS IN YIELD DUE TO COMPETITION BY WEEDS

Various estimates of losses due to weed competition have been made and usually run around 20% to 25%. We based our figures on these estimates, personal observations and quite extensive experimental work on land under crop in various parts of Manitoba. A series of plots were staked out in fields after they were sown in the spring, and half of the plots were kept weeded while the others were allowed to grow in the usual manner. In other fields plots of fairly clean land were cut and weedy areas in the same field compared. The yields from these plots gave figures showing from 15% to 70% reduction in the weedy plots. Taking into account the unevenness of the weed distribution and crediting the summerfallow with being fairly clean the estimate of 19% average reduction due to weed competition may be considered very conservative.

THRESHING WEEDS

As the threshing of weeds is paid for at the same rate as the grain, this item is self-explanatory. The threshing rates quoted are those used by the Dominion Experimental Farms.

FREIGHT ON 11,000,000 BUSHELS OF SCREENINGS

This figure is arrived at by multiplying the number of bushels of grain delivered by the average percentage of dockage for each of the grains reported by the Canadian Bureau of Statistics. The average freight rate for wheat from Western Canadian points can be considered to be 13 cents a bushel. The problem thus becomes a straight calculation.

COST OF HAULING 11,000,000 BUSHELS OF DOCKAGE TO ELEVATOR

There should be no criticism of a charge of 1½c per bushel for the average haul in the West, and as the 11,000,000 bushels of dockage undoubtedly arrives at the elevator it must be hauled there by the grower.

LOSS OF FEED ON THE FARM

At least 50% of the dockage is of excellent feeding value. If proper care is taken this material can be ground finely enough to destroy the germination of the great majority of weed seeds.

40% OF CULTIVATION OTHER THAN SUMMERFALLOW

Any of us who can look back to the days when all the cultural implements needed on any farm were ploughs and harrows, will agree that 40% is a very modest estimate of the increase that weeds cost us in our spring and fall cultivation charges. Those who were farming in the years when the open prairies of Saskatchewan and Alberta were first broken, and harvested good yields from crops disced into stubble will be sure that it is much too modest.

LOSS OF GRADE IN OATS AND BARLEY DUE TO WEEDS

One of the main reasons why our Western barley is not replacing more imported corn in the feed lots and dairy barns of Eastern Canada, is that the Eastern farmer refuses to take the risk of introducing so many weeds on to his farm.

That the loss of grades below 1 Feed Oats and 3 C.W. Barley are due to weeds is quite evident from an examination of the inspection sheets of the Dominion Government Grain Inspection Branch. Wild oats are the principal reason for the lowering of the grades. Crops which have been grown in competition with bad infestations of weeds are generally poor physical samples also.

REMAINING ITEMS

1. Wheat which contains any noticeable amount of ragweed or cockle is unfit for milling without an expensive cleaning operation.

A certain amount of grain is graded tough because the weeds that had to be cut with the crop prevented it from drying out.

2. Besides the extra work caused by weeds there is also a very large amount invested in special farm machinery to accomplish this work. This machinery has to be kept in repair and in due course replaced. There are more than 250,000 farms with an average area of about 200 acres in the West. One cultivator per farm means a charge of one and a quarter millions of dollars as interest on investment at 5% without considering repairs or depreciation.

3. Reduced values of forage and feed differ in the various areas of the West. Sow Thistle and Canada Thistle in sheaf feed are the worst trouble in a large part of Manitoba, while Fox-tail, Tumbling Mustard and Dry Russian Thistle are the special grief of the semi-arid regions. Taken altogether they take a considerable toll, particularly when we include also the quantities of cream rejected because of stink weed, and the tainting of milk due to its presence in pastures.

4. Cattle poisoning is a cost that is practically impossible to estimate due partly to the number of supposedly poisoned cattle which have died from malnutrition on weedy pastures. Overgrazing is one of the worst evils in the cattle raising business of

today, and is serious because of the unpalatable weeds which replace the grasses on overgrazed pastures.

5. Extra twine, labor and general handling costs at harvest time again varies according to the area. Where Russian Thistle is bad it may equal two-thirds of the cost but where wild oats or couch grass are the prevailing weeds the extra cost is not so high. Besides the difficulty of threshing a crop with high weed content there is no doubt that due to the presence of the weeds more grain goes over into the straw pile.

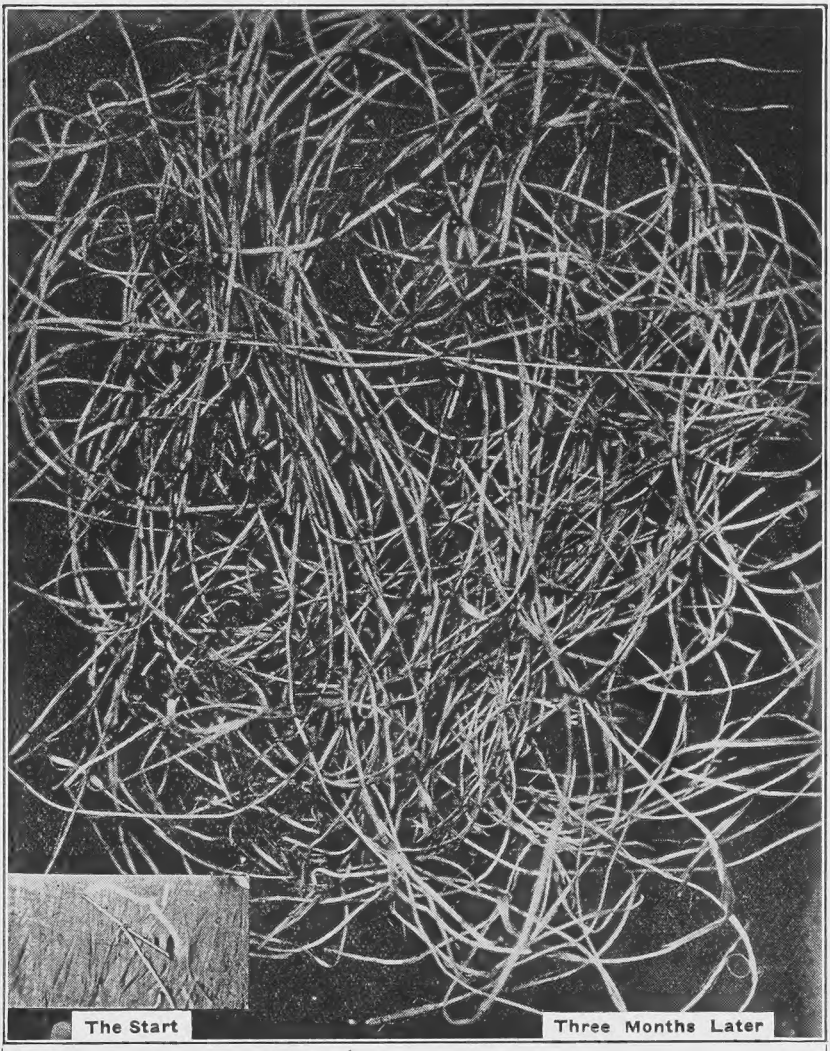
6. Cleaning charges are of three kinds, those on the farm, the country elevator, and the Terminal elevator.

7. Depreciated land values. This is difficult to estimate but sometimes constitutes the most serious loss of all. As proof of this fact one has only to visit large areas abandoned because of Quack Grass, Perennial Sow Thistle and several other weeds.

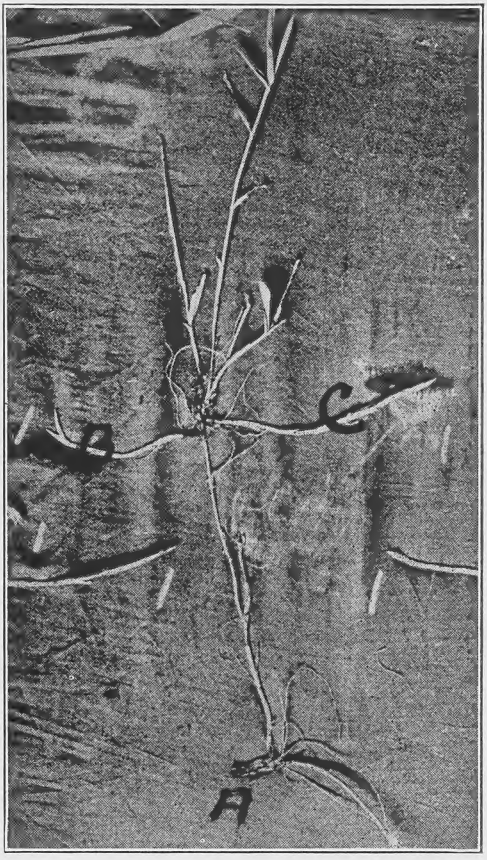
An exact estimation of the losses incident to the seven different items just discussed is difficult to determine individually. However a general figure of 40% of the total cost of cultivation as being chargeable to weeds, has been fairly definitely established by investigators in both Canada and the United States. According to the findings of the Canadian Prairie Illustration Stations, this 40% of production costs would amount to $179,200,000. The difference between this and the total of the items recorded individually represents the $9,523,693 appearing on the balance sheet as chargeable to the last seven grouped items.

The foregoing is a rather conservative analysis of the costs chargeable to weeds. The amount listed is approximately $120.00 for every person living in the rural section of the three prairie provinces. Some of the sources of loss have possibly become too well established to have much done about them, but others can be reduced considerably. It is hoped that a close perusal of this pamphlet will be of assistance to the farmers of Western Canada, in attaining this end.

Couch Grass and its Control

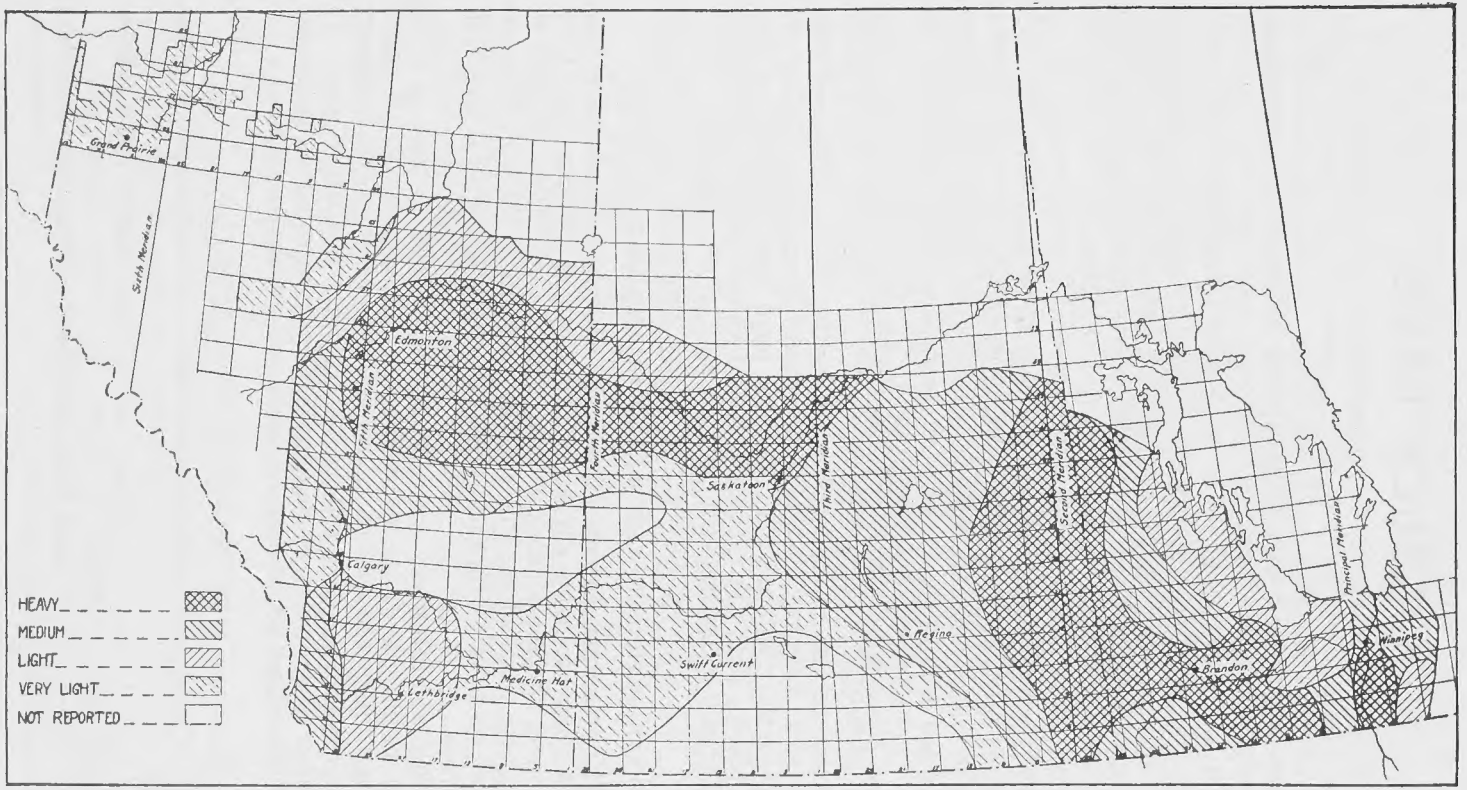


270 feet of Couch Grass Rootstalk.
A Single Season's growth from a Single Node on Red River soil.



The piece of rootstock marked "A" was buried 8 inches deep. It grew as illustrated and produced runners "B" and "C" only a few inches below the surface of the ground. This is what happens in an old undisturbed or pastured stand.

TAKEN FROM "REPORT No. 26, NATIONAL RESEARCH COUNCIL."



Distribution and prevalence of couch grass in Alberta, Saskatchewan and Manitoba, 1931.

In no case is the infestation general in the areas marked, but is rather an indication of the relative number of farms on which Couch grass is a serious problem.

COUCH GRASS

THE PLANT

Couch grass is a very close relative of western rye grass with this very great difference:

It Has a Very Active System of Under-Ground Rootstocks.

New Rootstocks Are Produced Each Summer from the joints of the ones which grew the year before. Most often they start at the joint where a plant is growing above ground, and they will grow to a length of from 12 inches to 100 inches.

They may have one branch or several.

They may be one inch below the surface or twenty.

They may start to grow anytime from May to July.

The leaves and stems above ground may be anything, from a few inches long to the stage when seeds are being formed, at the time new rootstocks start to grow.

The Rootstocks Which Are Produced During One Growing Season Die During The Next.

They may be all dead and rotted by the middle of June or they may still be hanging on when the ground freezes, but if they are left alone they will not die till others have been produced to take their place. It is the prevention of these new rootstocks getting established which forms the basis of all control measures.

DISTRIBUTION IN THE WEST PARTICULARLY MANITOBA

The accompanying map was designed from information gained from a very extensive survey of the Western Provinces by J. M. Manson of the National Research Council, the Manitoba part of which was checked by the writers and shows the completeness with which Couch Grass has invaded the West, except in the very dry areas.

The infestation of couch is more patchy than that of those weeds which have seeds that blow, and it may be very bad indeed on several farms in a municipality and not present at all on others.

Some areas in Manitoba are notoriously bad with Couch. In the Swan River valley, for example, the extra work necessary for its control must cost many thousands of dollars each year.

WHERE DID IT COME FROM?

1. Grass seed before proper inspection facilities were established.
2. Small lots of seed sent out to this country from friends and relatives in Europe.
3. Brome grass seed from Europe for forage crop planting at the end of the last century.

HOW DOES IT SPREAD?

1. By Seed.

Mr. Foulds, Chief Analyst of the Dominion Seed Branch, Winnipeg, reports that approximately one-half of the Brome grass sent to the Seed Branch for inspection from 1925 to 1927 contained Couch grass, and that it is impossible to clean Couch grass from Brome. Half the fields entered for certification as Couch free were found to contain Couch.

A considerable amount of the spread in new areas can be traced to the use of seeds by Western Rye grass and Brome grass which Have Not Been Certified By The Dominion Seed Branch Free Of Couch.

2. Couch Grass Hay.

Couch flowers about the same time every year, and seeds collected a few days after flowering have germinated. Couch grass seed which passes through the digestive tract of horses, cows or sheep is Not Killed.

Further spread of Couch is often accomplished by hauling over-ripe Couch grass hay over clean fields or pastures, or by feeding hay with viable seed, or by buying hay containing Couch grass in head.

3. Wash Water.

Seeds which are allowed to ripen and shatter on headlands, fence lines, and waste lands are a menace not only to the owner of the land but to every foot of land which may be touched by run-off water from that land.

4. By Running Rootstock.

The rootstock of Couch is the storehouse of reserve Food.

The green leaves are necesssary to manufacture food reserves.

Where there is lots of room for the plant to spread, One Green Shoot in the spring with an inch of rootstock can increase till it has produced between Two and Three Hundred Feet of the Storage Material ready to form a solid mat of grass the next year. This particular occurrence has been observed in the Red River Valley, not once but five out of six times when single shoots have been transplanted.

(a) The most fruitful method of spreading Couch by rootstocks is by transplanting short pieces from one field to another on cultivators, ploughs, harrows, muddy boots, pasturing cattle, etc.

(b) Another cause of bad infestations is by breaking up pastures, headlands, and fencelines alongside of otherwise clean fields, and carrying the rootstocks out into the clean land by means of the machinery used.

(c) Small patches of Couch in otherwise clean fields are enlarged and spread by working right through them with cultural implements.

IN WHAT MANNER DOES COUCH DO DAMAGE ?

By occupying the place of crop plants on the land.

By taking the food and moisture needed by the crop.

By increasing the necessity for more frequent summerfallow.

By increasing costs of power to work the land, and making necessary new implements to fight it.

By making cropping systems, that include alfalfa, clovers, or grasses, difficult to carry out.

HOW IS IT BEST CONTROLLED ?

By preventing the production and development of the new system of rootstocks, or by removing the new system of rootstocks from the soil. Couch Grass is the only one of our perennial weeds which has the underground part tough enough to pull out. It also has a top growth that is too tough to cut off easily with a cultivator. A system of pulling out the rootstock has proven therefore most successful in the majority of cases.

The roots are more easily removed from fields that have been pastured for some time because:

1. The rootstocks of Couch grass are all in the first few inches of sod on pasture fields. Rootstocks start growing at the base of the green plant, and the harder the ground becomes, the closer to the surface will be the point at which they start to grow.

2. The growth of new rootstocks on well established sod is comparatively small. Just enough new material is grown to replace the old.

3. The single rootstocks are shorter and have less branches, therefore they pull out all together more often than the longer rootstocks on cultivated land.

4. The new rootstocks do not start to grow on the old sod till several weeks later than on the cultivated soil.

TYPE OF CULTIVATION

A spring tooth cultivator is especially designed to drag the rootstocks to the surface.

Two days' exposure to the air will kill the rootstocks in damp weather.

A few hours' exposure to the hot sun and air will kill them in dry weather.

Where it is impossible to get a spring tooth harrow, an ordinary duck foot will do the job, but more work will be required. Whatever type of cultivator is used the ground should be gone over frequently after the job is once begun.

When starting to clean up a field bear the above in mind and don't take on more than you can handle thoroughly.

COMPLETE METHODS THAT HAVE PROVEN SUCCESSFUL

1. Most Successful—

Break the land in the fall after growth is completed for the season (as near freeze up as possible). Leave rough for the frost to mellow the sods. Cultivate with a couch harrow (spring tooth) as soon as possible the following spring (early June) and repeat the cultivations often enough to prevent green growth till all rootstocks are dried out. Seed heavy with Fall Rye if the work is completed early enough.

2. Successful in Heavier Types of Soil—

Pasture heavily till after seeding or if that is not possible cut a hay crop in early June and break. Cultivate at once with a couch harrow and continue throughout the season often enough to prevent green growth.

Seed early the following spring with a heavy seeding, barley being best to choke out any Couch which may be left.

3. Where Land Has Been Under Cultivation, and Where the Rootstocks Are Scattered Throughout the Top 6 to 11 Inches of Soil—

Plough two or three inches deep in the fall and leave rough.

Start cultivation in spring as early as possible. Continue as often as necessary to keep the land black, till most of the rootstocks are removed from the furrow slice. Replough crosswise deep enough to bring up the remainder of the rootstocks (about July). Continue to cultivate till fall or till all rootstocks have been removed. Seed grain, preferably barley, at a heavy rate the following spring. In general about one and a half or two times the rate usually used in the district is advised. The reasons for sowing grain at a heavier rate are that a heavy crop will tend to choke out any weak plants of Couch which may struggle through; also, the land should be in a condition to support a heavy crop. Barley is recommended because it is particularly effective as a smother crop, by reason of its extensive root system, which is concentrated near the surface of the ground. Oats produce a good smother crop in the areas favorable for them. Wheat is the least effective smother crop of the cereals and Durum wheat is less effective than common wheat. The methods previously outlined are the most effective and economical where Couch grass has established a firm hold.

In general any method that will prevent green growth appearing on a field for a complete growing season will prove successful if started early enough, but the prevention of green growth from Couch grass by any cutting type of cultivator, such as duck-foot, disc, etc., is extremely difficult.

A FEW GENERAL CONSIDERATIONS

Weather, soil, available moisture, are all things which have to be considered by the man intending to do the work.

Dry weather is the best in which to kill Couch. Sandy soils generally allow the rootstocks to penetrate deeper, and stoney soil prevents effective work by the machinery. Dry conditions retard the development of new rootstocks. All these are matters which the individual must consider for himself as they vary for every case.

The choice of machinery is not always a matter over which the individual has control. If a spring tooth is not available a duck-foot can take its place. Remarkably good jobs of cleaning Couch up in the Red River Valley with the implement in question have come under the writer's attention.

Ploughing very deep in an effort to bury the rootstocks has not proven successful with us, or with any one else, that we have met who has tried it. Some of the healthiest growth in our experiments came from sod buried 20 inches.

Smothering

Straw or manure piled on a small patch of Couch grass will effectively choke it out, if all light is prevented from getting to any part of the patch.

A fairly heavy covering of straw which does not altogether prevent growth, will cause the rootstocks to grow near the surface, and if properly used will assist in getting rid of small patches.

Prevention of Spread

Don't buy grass or clover seed which contains Couch grass seed.

Buy only Brome and Western Rye grass seed that is certified free from Couch by the Dominion Seed Branch.

Cut any Couch grass meadows before the end of June. The hay will be of better quality, and it will be safe.

Don't haul Couch grass, hay or any crop from a Couch grass field across clean land either cultivated or in sod, when it can possibly be avoided.

If you are breaking a headland or fence line, which contains Couch, into a field Do The Job Separately. Get rid of the Couch before you include the strip in your field.

Breaking up Couch grass pasture should only be started when a thorough job of eradication can be done before it is included in another field.

Manure from stock fed on Couch grass, hay or grain containing Couch seed should be well Rotted before being spread on the land.

Patches in the Field

Small patches should be worked around when working a field.

A potato fork is handy for digging out small patches if they are not too large.

Take care that pieces of rootstock are not carried from the edges of small patches to other parts of the field.

Chemicals

Only one chemical used in our experiments has been found effective with Couch grass:—Sodium Chlorate. Chemicals which contain sodium chlorate appear to be effective in proportion to the percentage of sodium chlorate they contain.

Straight Sodium Chlorate and Atlacide have proven effective, if used properly. Two pounds to 100 sq. ft. is the dose. This may be applied dry or with water. Just before a rain is the best time. A gallon of water is enough if a sprayer is used, two gallons with a watering can. These chemicals are dangerous when mixed with organic materials, such as cloth (overalls, sacks, shoes, etc.) and overalls soaked in these solutions have been known to burst into flame when dry, just with the friction of walking. Don't get the solution on your clothes or on sacks which may be put in a granary. If you do, rinse and wash them in lots of water. Land is rendered barren by these chemicals for a period of from one to three years, so it is not economical to use them on anything but small patches. They cost from ten to fourteen cents a pound, consequently are too expensive for large areas anyway. The full effect of treatment is not apparent until the spring following the application. If at that time there are still some plants alive, these should be sprayed a second time. The main action of the chemical is through the root. Get the chemical over the whole of the ground where any of the rootstocks might be.

A FEW THINGS TO THINK ABOUT

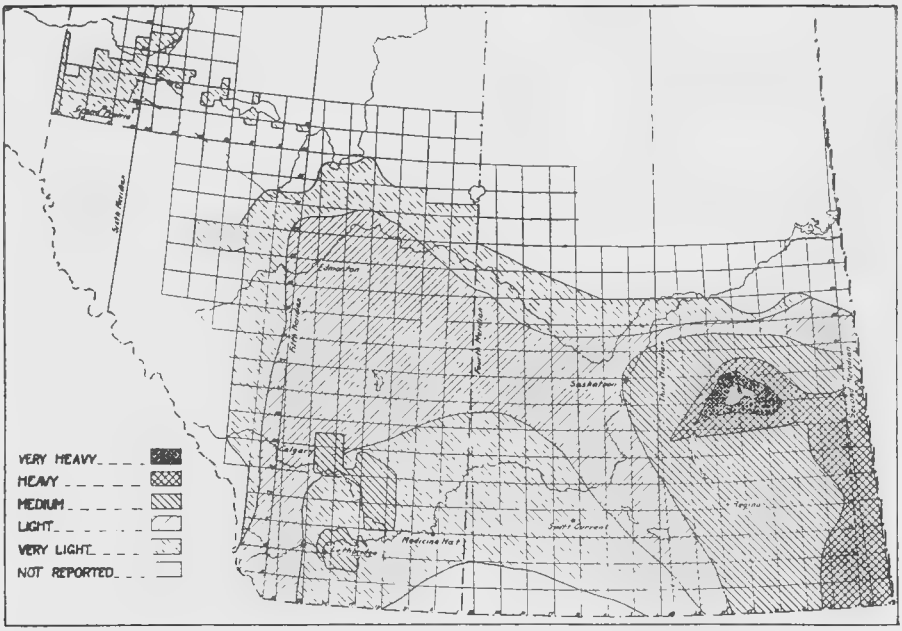
About the only way that Couch grass can get on your farm without your being able to prevent it, is by wash water.

A constant watch to prevent its introduction may avoid years of toil in getting rid of it. When you have once got your farm clear of Couch you can keep it clear. This makes the extra effort worth while. Getting rid of Couch is hard work and thorough methods thoroughly carried out are necessary.

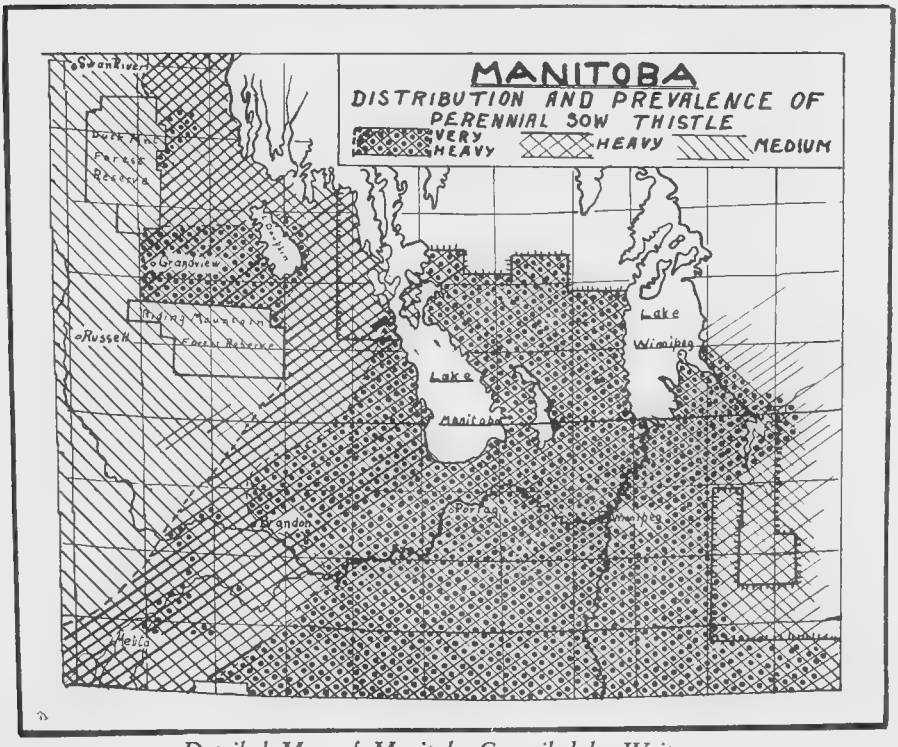
Don't put a plough into Couch until you have figured how much you can handle, and how you are going to handle it. Couch sod broken up and not cleaned up is a worse mess than if it was left alone.

The Control of Perennial Sow Thistle

New Shoots in the Spring originating from the top of old growth frozen off the previous fall.



Distribution and Prevalence of Sow Thistle in Alberta and Saskatchewan, 1931
—From Report No. 26—National Research Council.



Detailed Map of Manitoba Compiled by Writers

The Control of Perennial Sow Thistle

THE PLANT

The Perennial Sow Thistle belongs to that important group of plants which have a large number of flowers grouped together in a composite head. Some of its best known relatives are Canada Thistle, Dandelion, Chicory and the Sunflower.

In common with humans, traits both desirable and undesirable, are frequently possessed by whole families. In the instance of the Perennial Sow Thistle the characteristic of producing flowers in which the seeds are equipped with a downy flying apparatus is distinctly undesirable from the standpoint of the farmer. By means of this up to date method of transport the seeds may be carried long distances by the wind and thus spread the infestation over widely scattered areas.

The first growth in the spring is a circular crown of leaves usually from 10 to 14 inches in extent. The flowering stalk is produced in a week or ten days before the first bloom appears and grows very rapidly. The flowers are very showy, being bright yellow and having 68 to 200 flowers to each head. The uppermost terminal head is the first one to bloom and the remaining heads follow in a regularly planned succession. Each plant may develop anything up to 60 heads which will bloom over a period of almost two months if favorably located.

The flowers depend on insects for pollination and as these are much less plentiful in the early flowering periods seed setting is usually light at this stage of development. Later in the season, however, flowers frequently produce 100% of seed. The flowers begin to fade about 5 days after their first appearance and from 7 to 15 days later the ripe seed is ready to take its flight.

Although there is danger of the blown seed causing new infestation **the most troublesome part of the plant is the root.** The roots spread in all directions from the base of the flowering plant. They run within a few inches of the surface of the ground and send branches straight down into the lower soil at frequent intervals. Buds form all along the roots and develop into new plants. The current year's roots send only leaf growth to the surface but produce flowering stalks the following year, after which they die off, but not until they have produced a new set of roots for the succeeding year. Successful control is measured by the extent to which this new set of roots is prevented from developing.

DISTRIBUTION IN THE WEST, PARTICULARLY IN MANITOBA

The accompanying map of Saskatchewan and Alberta was designed from information gained during a very extensive survey of the Western provinces my J. M. Manson of the National Research Council, and shows that Sow Thistle is gradually invading the farther Western areas, even to some extent in the so-called dry belt.

The map of Manitoba is the result of a more detailed survey made by the writers during the last three years. It shows that the original infestation in the Red River Valley has spread North East and West till it has become so serious in a good part of the province that it entirely modifies the cultural practices used or else it modifies the farmer to a point of bankruptcy. The noticeable features of the map are: first, the heavy area around Lake Dauphin and the strip between Duck and Riding Mountains and, secondly, the scattered bad areas from Melita along the Souris River. The cause of the bad infestation out from Lake Dauphin is most likely due to this being longer settled and more extensively farmed. The adjoining areas have very little cultivated land and are extensively wooded and it is most likely these conditions which have protected the Swan River Valley so long. There is a local condition in the Souris River Valley which favors the spread of Sow Thistle. A soil survey of that district, made in the fall of 1933, showed that part of that area had a constant supply of moisture in the lower subsoil due to drainage from the high lands on either side and this condition would be very favorable to a plant of the Sow Thistle type.

There are two conditions which do not show on the map but which are worthy of consideration. First, there are at least two or three areas in Manitoba where all the low land such as sloughs and creek edges, pot holes, etc., are growing perfect stands of Sow Thistle, although the fields are not yet badly polluted. Every effort should be made to keep such infested areas cut or grazed to prevent the seed blowing on to cultivated land and the edges of fields cultivated to prevent the invasion of roots. These areas occur from Dauphin through Ethelbert to Swan River, from Minnedosa up to Foxwarren and in the Eastern area where peat is common in the low lands. The second condition is the ease with which Sow Thistle has adapted itself to dry conditions. It is quite common to find Russian Thistle and Sow Thistle competing together for the total elimination of the crop on dry lands.

WHERE DID IT COME FROM?

We cannot be quite certain where Sow Thistle came from, only that it is Not native in America and Is native in Europe. The first official report of it in Western Canada is in Hanover county in 1887, and at that time it was scattered in small patches throughout the Red River Valley. The possibilities are equally divided between its introduction by settlers from Russia and by means of seed and traffic from the South.

HOW DOES IT SPREAD?

1. By Seed.

Sow Thistle belongs to a group of plants that became air minded long before man did and the seed is provided with complete flying equipment. When a Sow Thistle seed takes off from the top of a plant it is not at all particular about a landing field, consequently, it is almost impossible for a farmer to guard against

this kind of invasion without the co-operation of all his neighbors, thus the first weed to be designated as "Primary Noxious" in most Weed Acts is Sow Thistle.

The percentage of seeds which germinate and produce plants is not high but when one considers that one plant may produce as high as 9,000 germinable seeds and a patch 10 feet square may contain 200 plants, the percentage germination does not need to be very high to be dangerous. Damp conditions are almost necessary to obtain germination and when the fluffy seed lands in a wet spot it stays there. Almost all seeding patches start in low ground that is damp in the spring and the seedlings develop early and thus avoid destruction by the hot dry condition of midsummer. Once started, the roots will carry them to the driest knoll.

Manure containing Sow Thistle seed is a very efficient agent for spreading this weed. This fact can be illustrated by reference to a fertility experiment conducted at the Manitoba Agricultural College. In the experiment in question twelve plots were given different fertilizer treatments which were applied every fourth year. The fertilizers used were green manure, rotted manure and chemical fertilizers.

In 1933 an analysis was made of this experiment, which has been running a number of years, to check on the weed content of the different plots. It must be kept in mind that the land originally used for this experiment was uniform with regard to its weed content, so that any change could be traced largely to the fertilizer treatment.

On the land treated with green manure the Sow Thistle had increased to an average of 24,000 flowering stalks per acre, while the chemical fertilizer plots only showed 120 flowering stalks per acre,—a good demonstration of the weed seed carrying possibilities of green manure.

Other ways in which Sow Thistle seed may be distributed are by the seed drill when polluted seed is used and from fodder which has partly matured Sow Thistle seed in it.

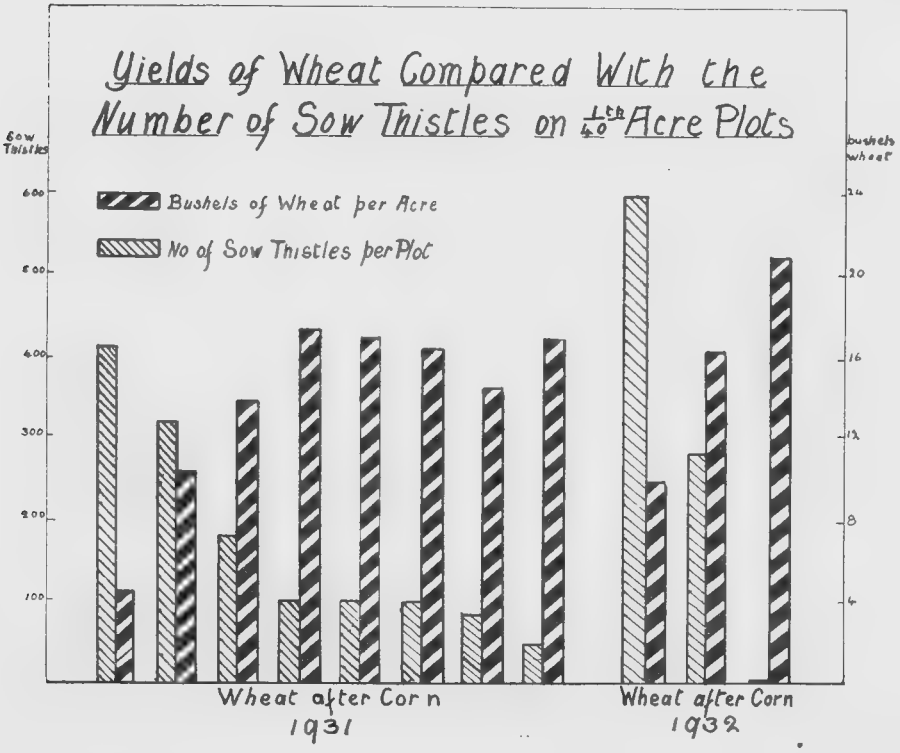
Experiments have demonstrated that 70% of the heads from which the yellow petals have dropped will produce viable seed. As a consequence **particular care must be taken to cut Sow Thistle before the first flowers fade** if the damage from new seedlings is to be avoided.

2. By Roots:

The system of lateral and vertical roots of Sow Thistle spread in all directions from the flowering plants and cover new areas to the extent of from six to twenty feet across each year. One plant which grew the minimum amount of six feet of roots around it each year would cover an area of 113 square feet in the second year, 452 square feet the third, and 1,018 square feet in the fourth year if it was left alone. The ordinary cultivation for stubble crops would most likely spread it three times that far by cutting up the roots and dragging them over the fields.

The roots of Sow Thistle are the storage houses for food by which the plant carries on from year to year. They start to grow from the bottom of the flowering stalks any time between early June and late July, according to the weather and soil conditions. They grow along parallel to the surface of the soil and send crowns of leaves up to the surface. These leaf crowns are the manufacturing plants for the food which is stored away in the roots for the next spring. Branch roots are sent straight down into the ground these are the reserves which are called into action when the top runners are killed off. In the spring the runners produce buds every few inches along their whole length. These develop into new plants which this time produce flowers and seed. The whole process of enlargement then is repeated from each of these new flowering plants.

Chopping up the roots into small lengths with a disc harrow and then dragging them over to clean parts of a field or to new fields is one of the commonest methods of spreading Sow Thistle. Pieces of the root only $\frac{1}{8}$ of an inch long will produce good healthy plants, and if there is no bud on them they will grow a new shoot out of the end.



IN WHAT MANNER DOES SOW THISTLE DO DAMAGE?

By occupying the place of crop plants on the land.

By taking food and moisture needed by the crop.

By increasing the frequency of summerfallow.

By increasing the cost of cultivation due to more frequent work and more costly equipment.

That Sow Thistle affects the surrounding crop is amply illustrated by the following tables:

Table 1.

AVERAGE REDUCTION IN YIELD OF WHEAT PLANTS GROWING AT DIFFERENT DISTANCES FROM SOW THISTLE PLANTS

	Average number heads per plant	Average number spikelets per head	Average number grains per spikelets	Number plants to produce one bus. wheat	% loss in yield
1. Wheat plants with 3" of a Sow Thistle plant	1.3	5.3	1.35	86,869	80.42
2. Wheat plants growing within 6" of a Sow Thistle plant	2.83	10.1	1.70	17,010	

Table 1. illustrates very clearly the reason why wheat plants growing near Sow Thistle fail to produce a satisfactory yield. Not only do such plants produce fewer heads per plant but the number of spikelets per head and the number of kernels per spikelet are similarly reduced.

Table 11.

RESULTS FROM A FIELD OF REWARD WHEAT PARTLY INFESTED WITH SOW THISTLE

	Average number heads per plant	Average number spikelets per head	Average number grains per spikelets	Number plants to produce one bus. wheat	% loss in yield	Average number plants per ft.
1. Wheat containing 7 Sow Thistles per two sq. foot	1.3	5.6	1.60	69,029	71,06	10
2. Wheat free from Sow Thistle	1.97	8.26	1.78	28,537		15

In Table 11. the same type of reduction occurs when Sow Thistle infested areas in a field are compared with adjoining areas free from this weed. In this instance not only is the yield of the individual plant seriously interfered with but the number of plants is appreciably lessened.

HOW IS SOW THISTLE BEST CONTROLLED?

By preventing the production of running roots. This is only possible by preventing the storing of reserve food supplies, which must be manufactured by green leaves. Therefore, if you prevent green leaves from growing after the middle of June you will have the Sow Thistle controlled.

METHODS:

Disc stubble in the fall if possible to get annual weeds to grow in spring. Plow about 15th to 20th of June and cultivate with a duck foot or other surface cultivator as often as is necessary to keep the field completely black. Always run the cultivator as shallow as possible. The condition which should determine when you plow your summerfallow is whether the Sow Thistle has started to grow a new set of running roots. Summerfallow started after the new roots have attained a good growth will require a lot more work and will not give as good results. The only way one can tell if the new roots have started is to dig up a few of the plants and see if the new growth is noticeable at the base.

2. SWEET CLOVER HAY:

This method is advised only in areas where it is not necessary to summerfallow to conserve moisture. Sweet clover is sown with the crop previous to summerfallow. The hay is cut as soon as the first clover flowers begin to show, and stooked on the plowed land. The land is kept cultivated as in method one, only it will most likely not need to be done so often. The growing of sweet clover is by far the best method of Sow Thistle control where lack of moisture is not a factor, for the following reasons:

(a) A crop of hay is obtained.

(b) The tilth and fertility of the soil is improved.

(c) The Sow Thistle is subjected to a competition which reduces the amount of roots produced in the fall and delays the production of new roots in the fallow year.

The requirements for this method to be a success are: First that a good catch of clover is obtained. If the catch is patchy it is best to disc and broadcast clover right behind the binder or wait till spring, disc, and sow oats early. The oats and clover may be cut together as soon as the clover is ready. This will be early for the oats but will give a first class feed just the same.

The second requirement is that you cut your clover early enough and plow right after. This ensures that you get after the Sow Thistle before it forms new roots. Don't save part of a field meant for summerfallow, for clover seed. Use a piece of clean land to grow your seed, otherwise, it will be almost impossible to kill the Sow Thistle on this piece.

A FEW GENERAL CONSIDERATIONS:

Perennial Sow Thistle roots cannot be dragged out of the soil because they break off too easily and also have vertical branches which grow many feet into the ground.

If green growth is allowed to develop on well cultivated soil for a few weeks in early fall enough new running roots can be produced to pollute the next season's crop.

The roots that go straight down are just as active in producing new plants as those which are close to the surface, once the surface ones are cut off them.

The object of cultivation is to cut off the new leaf growth as near the surface as possible. Deep cultivation often just transplants cuttings of the roots without injuring the growth very much.

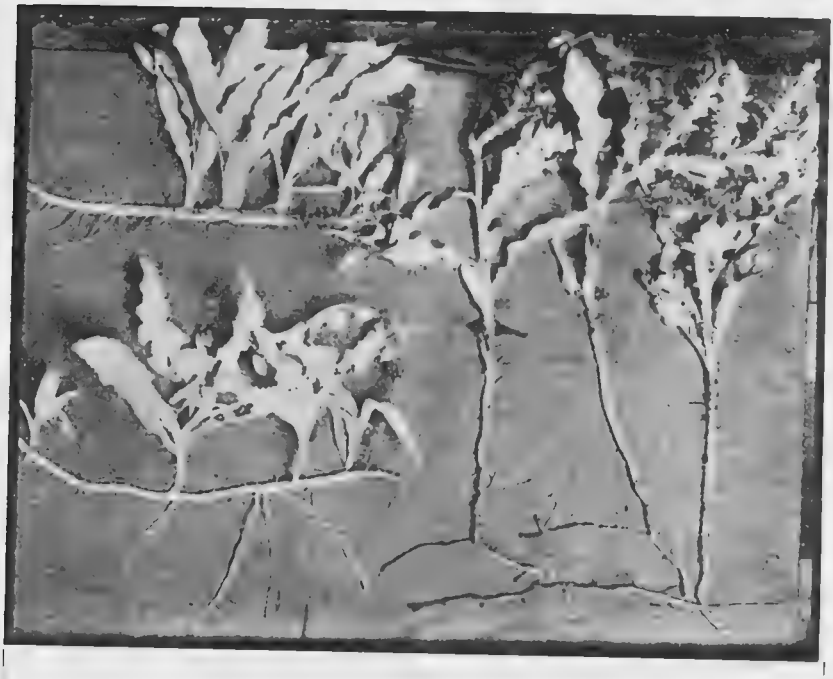
Any type of cultivation which keeps the soil completely black for a whole season will be successful. Cutting Sow Thistle above ground does not control it. It only prevents the seed forming. Small patches may be dug out with a fork or kept black with a hoe, if they are not too extensive. Otherwise, it is best to go over these patches separately with the cultivator whenever necessary.

Manure or straw piled on small patches for two seasons will get rid of them if all light is kept out and patches completely covered.

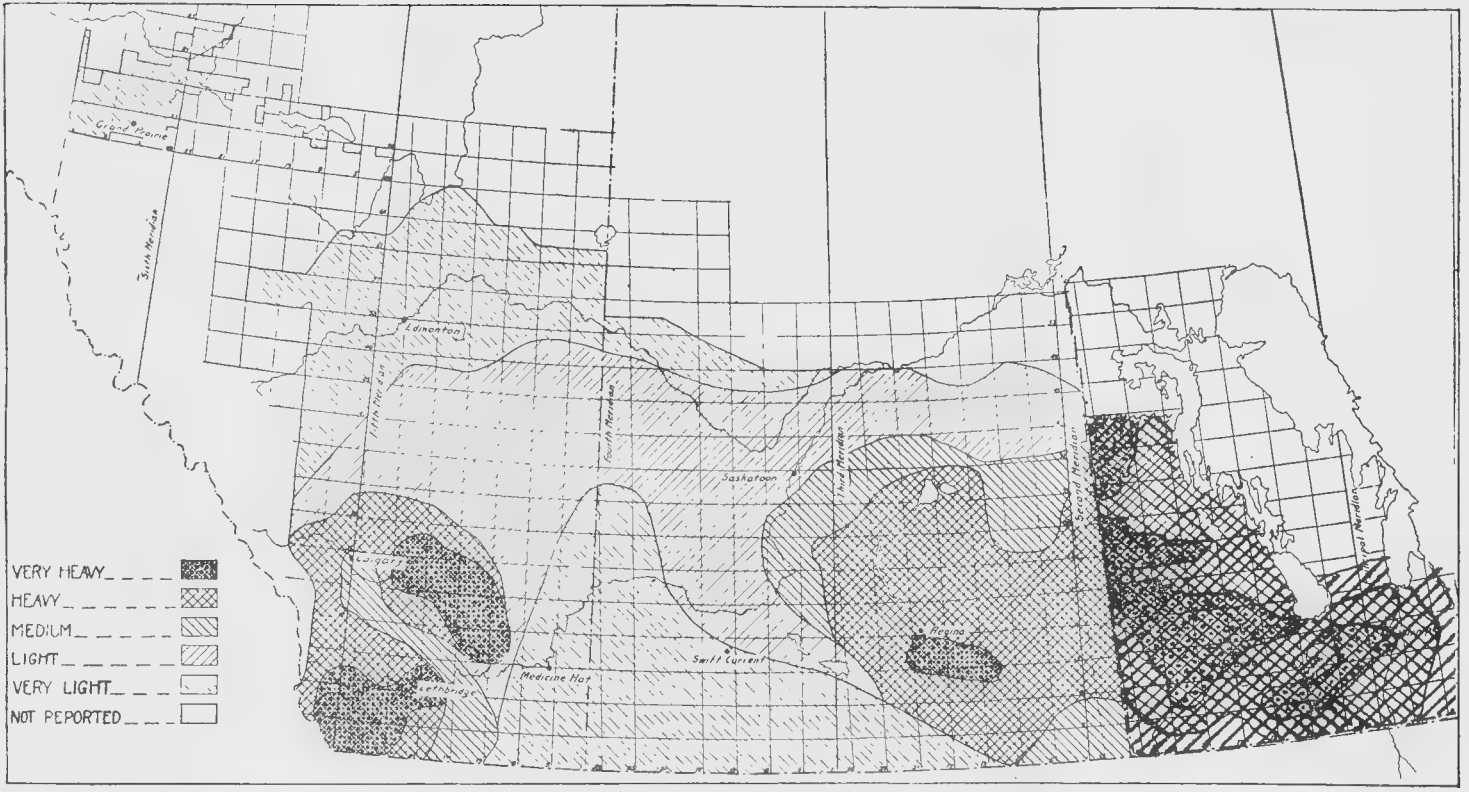
CHEMICAL CONTROL:

The most effective chemical which has been tested by the writers, up to the present, is sodium chlorate and weed killers which contain this chemical are generally efficient in proportion to the amount of sodium chlorate they contain. About a pound of sodium chlorate will kill out 100 square feet of Sow Thistle. As these chemicals are expensive and leave the land barren for one or two years they are only recommended for small patches.

The Control of Canada Thistle



The roots of Canada Thistle, on the right, develop much deeper in the ground than those of Perennial Sow Thistle, on the left.



Distribution and prevalence of Canada Thistle in Alberta, Saskatchewan and Manitoba

CANADA THISTLE

THE PLANT

Canada Thistle is a true thistle in that it belongs to that group of plants with many flowers in a composite head and is uncomfortably prickly.

The flowers are purple and of two kinds, male and female. These differ very little in appearance. The female heads produce seeds which are attached to long downy hairs after the flowers fade, while the male heads just fade and dry up. The leaves are lobed and covered with sharp prickles, as also are the stems and the recepticles of the flowers.

The underground part of the plants consists of a number of long thickened roots which spread in all directions from the base of the flowering plant. They run more or less parallel to the surface of the ground at a depth of from four to ten inches. At varying intervals the roots turn and grow straight down but they branch at the bend and continue to extend lengthwise, just a little deeper than before.

DISTRIBUTION IN WESTERN CANADA

The accompanying map was designed from information gained during a very extensive survey of the Western Provinces by J. M. Manson of the National Research Council. The Manitoba part was checked and corrected by the writers. The map shows that while this weed is even more wide-spread than Sow Thistle it does not invade whole areas to the same extent and is not such a continual menace.

It is especially favored by certain conditions which make for extremely bad infestations in some areas. Noticeable among these are the two irrigation districts in Alberta. In no location is the infestation as general as that of Sow Thistle in localities such as the Red River Valley.

WHERE DID IT COME FROM?

Although a native of Europe it appears to have been one of the earliest of the bad weeds to be introduced into North America and has been a source of annoyance to farmers from the earliest agricultural history.

HOW DOES IT SPREAD?

1. **By Seed—**

A certain amount of seed is spread by wind, but Canada Thistle seed is generally very lightly attached to its parachute and does not often travel far. Sometimes the seed is left right in the recepticle.

Thistles carried in crop seeds are a very real danger, as they seem much more ready to grow under the same conditions as the

crop than do some of the other perennial weed seeds. Manure is a most fruitful source of seed infestation, as is also straw and feed which may be scattered around. There are many more weed seeds left in straw from a Canada Thistle field than from a Sow Thistle field of the same kind, due to the greater numbers of Canada Thistle seed being retained in the head.

Hay meadows are often infested with this weed and as stock cannot eat it, the thistles are scattered around if stock are fed outside.

2. By Running Roots—

Like most perennials, Canada Thistle stores its reserve food supply in the roots. These roots are also the place where most of the new plants start each spring. Consequently they are the greatest cause of spread.

The running roots are located so deep in the soil in most cases that the danger of spreading with cultivating implements is not nearly as great as with Sow Thistle and Couch Grass.

The roots do not spread quite so far each season as Sow Thistle, but the spread is steady and if not checked will gradually eliminate all other growth. This is as true of pastures and hay meadows as of cultivated land.

IN WHAT MANNER DOES CANADA THISTLE DO DAMAGE?

By crowding out field and forage crops.

By taking plant food and moisture from crops.

By increasing the difficulty of cultivation.

By reducing the value of forage crops.

By increasing the difficulty of handling crops.

By increasing costs due to increased cultivation, frequency of summerfallow, and special machinery.

HOW IS IT BEST CONTROLLED?

A complete black summerfallow or some modification of this practice will starve out the roots.

Like Sow Thistle and Couch Grass, Canada Thistle depends on the running roots for food to start new plants in the spring. The new set of running roots in turn depend on the new plants to start them. Therefore, if the food reserve in the old runners is exhaused before the new runners are established the plant is killed out.

Any type of cultivation which will keep the area in which Canada Thistle is growing entirely black for one growing season will control this weed, provided it is started before the plant has established a new set of running underground roots and all green growth is kept completely cut off.

TYPE OF CULTIVATION

Canada Thistle roots are too deep to be all turned up by a plough or cultivator. They are too brittle to pull out. Even if you could loosen them up they have vertical branches which go straight down from two to ten feet into the ground. These branches send up new plants just as readily as the horizontal runners. Most duck-foot cultivators are not rigid enough to cut off the top growth of Canada Thistle which is tough and stringy. Unless the blades are extremely sharp there is an inclination for them to slide around the plants, or possibly bury them without cutting them off.

Having heard repeated complaints that the ordinary summerfallow methods were not proving successful with Canada Thistle the writers of this pamphlet made critical inspections of some hundreds of summerfallows on which Canada Thistle was found growing. Sow Thistle was often being completely controlled on the same field. In every case it was found that the implement being used was not cutting off the top growth of the weed, but was either sliding around it or just covering it up without cutting it off. Usually the thistle patches were green again forty-eight hours after cultivation. From our own results and the results obtained by others, we have proven that Canada Thistle can be controlled by keeping the green growth cut off just below the surface of the ground, for one growing season. Therefore, the statement is quite justified that 90% of the unsuccessful summerfallow for the control of Canada Thistle are due to the failure of the implement to cut off the top growth of the plant. For cutting off the top growth rod weeders have proven very successful in the heavier types of soil. Whatever type of cultivator is used, it should be put in the best possible condition with the object in view of completely cutting off all green growth every time the field is cultivated. As much side play as possible should be corrected on the duck-foot, and wide sharp shovels should be used.

COMPLETE METHODS WHICH HAVE PROVEN SUCCESSFUL

1. In Dry Areas where moisture conservation is a consideration—

Give some surface cultivation in fall or early spring, to induce a good growth of annual weeds before the field is ploughed.

Plough the field at the ordinary depth after seeding time and cultivate throughout the summer as often as necessary to keep all green growth cut off. Cultivate as shallow as possible, remembering that the only object in cultivating is to keep the weeds cut off.

2. For Areas where moisture conservation is not a consideration—

Sow down to sweet clover with the crop previous to summerfallow. Make sure that a good stand of sweet clover is obtained. If this is patchy when the grain is cut, run a disc over the field and broadcast more sweet clover.

If the field looks patchy in the spring disc and sow oats as early as possible.

Cut the feed when the first of the sweet clover blossoms are visible.

Plough right behind the binder and continue to cultivate as in the previous method.

With both these methods the thoroughness with which the work is done will measure the success attained.

In ploughing, the shears should be kept sharp so that the furrow is completely cut and turned. A rod weeder, cable weeder, or broad toothed cultivator can be used to cultivate, if the object of cutting off the top growth is remembered.

3. Canada Thistle in Pasture and Hay Meadows—

It has been mentioned before that the underground parts of this weed depend on the green leaves to manufacture food for them. By taking advantage of this it is possible to weaken and eventually kill out patches of Canada Thistle in sod land.

As soon as the thistles are high enough to cut, a mower is run over the patch, and this is repeated as often as they grow high enough. The location will affect the length of time it takes to completely eradicate the patches, but even one years' work if started early will considerably weaken them. One cutting in May is worth four in July.

A FEW GENERAL CONSIDERATIONS

If land which contains thistles is to be cropped, early fall ploughing right behind the binder is the best preparation. If possible, fall cultivation should be given and the seeder should follow right behind spring cultivation.

Where there are small patches in a field a dutch hoe can be effectively used to keep the top growth cut off if the patches are not too large or too numerous.

Where there are a number of patches in a summerfallow where annual weeds are the greatest trouble, such as wild oats, mustard, etc., it is often best to cultivate the thistle patches separately. The whole field can be cultivated when there is a good green growth. and in between times the thistles can be given one or two extra cultivations.

Canada Thistle seed is much commoner in commercial seeds than Sow Thistle, so watch when you are buying seed, also when you are cleaning your own seed.

Canada Thistle can usually be kept off land when you once get rid of it, therefore, the extra effort is worth while.

CHEMICALS

Only one chemical used in our experiments have proven effective with Canada Thistle, namely sodium chlorate. Chemical weed killers which contain sodium chlorate, appear to be effective,

in proportion to the percentage they contain. Straight sodium chlorate and Atlacide have proven effective if used properly. Two pounds to 100 sq. ft. is the dose. This may be applied dry or with water. Just before a rain is the best time. A gallon of water is enough if a sprayer is used, two gallons with a watering can. These chemicals are dangerous when mixed with organic materials, such as cloth (overalls, sacks, shoes, etc.) and overalls soaked in these solutions have been known to burst into flame when dry, just with the friction of walking. Don't get the solution on your clothes, or on sacks which may be put in a granary. If you do, rinse and wash them in lots of water. Land is rendered barren by these chemicals for a period of from one to three years, so it is not economical to use them on anything but small patches. They cost from ten to fourteen cents a pound, consequently are too expensive for large areas anyway.

The full effect of treatment is not apparent till the spring following the application. If at that time there are still some plants alive, these should be sprayed a second time. The main action of the chemical is through the root. Get the chemical over the whole of the ground where any of the rootstocks might be.

SMOTHERING

A pile of straw or manure if completely covering a patch of thistle and preventing all light getting at it, will smother it out in a couple of seasons.

SEE THAT ALL GREEN GROWTH IS COMPLETELY CUT OFF WHEN CULTIVATING

Weed Seeds in Silage

Weed Seeds do not live long in properly made Silage.

WEED SEEDS IN SILAGE

In years when the usual kinds of fodder are scarce, many farmers find themselves under the necessity of ensiling types of plant growth that would be discarded under ordinary circumstances. At such times there is always a special interest in the question of what happens to viable weed seeds that are included in silage.

Even under ordinary circumstances many fields that are producing crops intended for the silo are far from being free from weeds. The net result of it all is that most forms of silage contain from a few to many weed seeds.

It has been repeatedly demonstrated that whole weed seeds may pass through the digestive tracts of animals without having their germinating ability injured in any way. As a consequence, if ensiling does not destroy germination the subsequent feeding is not likely to do so.

The present pamphlet is an attempt to answer the question of the fate of weed seeds in silage, in the light of two years of experimental evidence secured by the Department of Agronomy, University of Manitoba.

A series of experimental, galvanized iron silos were available for the tests. These silos were thirty inches high and thirty inches in diameter and were supplied with wooden lids constructed to fit snugly inside the silo so that pressure might be applied uniformly to all parts of the enclosed silage.

When the commercial silos were being filled with corn sufficient silage was obtained to fill all of the experimental containers. When the small silos had been packed to approximately half their capacity, a thin cotton cloth was spread over the surface. Weed seeds of various kinds were placed on this cloth and a second cloth was used to cover them and permit of their being definitely located at the conclusion of the experiment. The silos were then filled to capacity, covered and weighted with a sufficient number of sacks of sand to produce a pressure somewhat similar to that occurring in a commercial silo of average capacity.

At intervals of twenty-four hours a record was kept of the temperatures within the different silos. These records were continued until well after all upward trend in temperatures had ceased. That the conditions obtaining in these experimental silos were at least reasonably close to normal, was evidenced by the fact that the silage secured could not be distinguished in any way from the product of the commercial silos.

At regular intervals, the seeds were removed and sent to Mr. Foulds, the seed analyst in charge of the laboratory of the Dominion Seed Branch, Winnipeg. Here an exact germination test of all seeds was made and the results reported to the writers.

The following table gives a list of the weed seeds tested in the various silos and the extent of their germination after fourteen days in the germinator. If no growth was apparent it was assumed that the seed had been killed by its sojourn in the silo.

1932 Results Kind of Weed Seed	Percent of Weeds That Grew During 14 Days in Germinator					
	Before Ensiling	Ensiled 2 weeks	Ensiled 4 weeks	Ensiled 5 weeks	Ensiled 6 weeks	Ensiled 8 weeks
Ball Mustard	52	0	0	0	0	0
Barnyard Grass	61	0	0	0	0	0
Blue Burr	94	0	0	0	0	0
Broad Leaf Platian	94	0	0	0	0	0
Cow Cockle	2	0	0	0	0	0
Falce Flax	66	0	0	0	0	0
Hares ear Mustard	69	0	0	0	0	0
Indian Mustard	99	0	0	0	0	0
Lambs Quarters	76	0	0	0	0	0
Leafy Spurge	—	0	0	0	0	0
Night Flowering Catchfly	68	0	0	0	0	0
Perennial Sow Thistle	85	0	0	0	0	0
Purslane	46	0	0	0	0	0
Red Root Pigweed	46	0	0	0	0	0
Russian Pigweed	28	0	0	0	0	0
Russian Darnel	—	0	0	0	0	0
Shepherds Purse	60	0	0	0	0	0
Stinkweed	65	0	0	0	0	0
Tumble Weed	21	0	0	0	0	0
Wild Oats	95	0	0	0	0	0
Wild Buckwheat	—	0	0	0	0	0
Yellow Foxtail	—	0	0	0	0	0

The results reported in the table are for weed seeds that were taken from the centre of the silo and surrounded by normal silage. It will be noted that under the conditions existing in our experimetal silos **not a single variety of weed seed tested retained its ability to grow after a few weeks in the silo.** In as far as corn silage is concerned and quite probably other properly made types of silage as well no great fear need exist of spreading weed seeds by feeding silage.

In addition to the weed seeds placed in the centre of the silos, some silage was included that had a plentiful supply of weed seeds mixed throughout. In these silos samples were extracted from different levels. Usually the top few inches of silage is mouldy even in very carefully filled silos. In this mouldy area some of the more resistant of the weed seeds, as for example Red Root Pigweed, germinated freely even after a sojourn of eight weeks in the silo. In any location where excess air could penetrate, as for instance immediately surrounding any hole in the wall of the silo, the weed seeds retained their ability to germinate.

In trench silos where the exposed surface of silage is very much greater than in the case of the round silo, it would be expected that more weed seeds would survive. However, all mouldy

areas should be discarded and following such a practice would prevent the spread of live weed seeds from this source.

Having established the fact that the germination of the weed seeds tested was destroyed by proper ensiling under the conditions of our tests, the question naturally arose as to what actually killed the seeds. There were several possibilities in this connection. One was that the temperature, associated with the early stages of ensiling, was sufficiently high to destroy germination.

In order to secure information on this phase of the investigation, the temperature records secured during the ensiling process were examined in detail. The highest temperature recorded in any of the experimental silos was between 73 and 74 degrees Farhenheit. Such temperatures are certainly not sufficient high to damage the germination of most weed seeds. In addition to securing temperature records in the experimental silos similar information was secured from one of the commercial silos that had been filled at the same time as the experimental containers. The upper limit of temperatures in this large silo ranged from 100° F. at the top of the silo to 80° F. at a depth of four feet. Even the highest temperature would not be sufficient to destroy the germination of many weed seeds. Something else must be the killing agent.

The next method of attack was to begin a series of analyses of the various substances present in the silage juice. This phase of the experiment is still under way and the presence of a number of different substances has been established. While nothing has been definitely proven, the evidence to date points to the probability of various acids playing a prominent part in rendering the weed seeds in silage safe for feeding by destroying their germination.

Chemical Weed Killers

The use of chemicals to kill weeds is certainly not a new idea. Records of weed control endeavors have contained for years references to chemicals of various kinds being used for the destruction of undesirable plants. In spite of this fact the use of chemicals in any general way to control weeds has not progressed very far. A consideration of the requirements of a satisfactory weed killer may enlighten us as to the difficulty of securing such a product.

In the first place it must be cheap and readily obtained. It must be easily and safely applied and it should not leave harmful residues on the soil for a longer time than is required for the killing of the weed being treated.

In the case of annual weeds in growing crops it must kill the weeds without unduly harming the associated crop plants. In this instance also it must be sufficiently cheap that the cost of the spraying will be more than compensated for by the increase in crop yields due to the destruction of the weeds. On the whole the requirements for a satisfactory chemical weed killer are sufficiently exacting to account for the lack of progress in their development.

No attempt will be made in this publication to give an account of the numerous materials that have been tried and found wanting. It will be sufficient for our purpose to list the more promising chemicals for the control of both annual and perennial weeds, along with recommendations for the rates and methods used in their application.

THE PURPOSE OF WEED CONTROL BY CHEMICALS

The object of using chemicals to control weeds is very definitely the same as the use of cultivation of any kind, namely the prevention of their growth and seed setting. If this fact is kept in mind the limitations of chemical control will be easier to understand.

It should be quite obvious that where cultivation can be satisfactorily carried out that such a system of control would be considerably cheaper than using a chemical spray. Only where cultivation cannot be done satisfactorily, or where the type of weed is such that cultivation does not appear to be effective, is the use of chemicals really justified.

THE CONTROL OF ANNUAL WEEDS BY CHEMICALS

Of a great many chemicals tested during past years, a very few have combined the desired qualities of cheapness and effectiveness. The three that have been used to the greatest extent in the control of annual weeds are iron sulphate, copper sulphate and sulphuric acid. Of these three the sulphuric acid appears to be the most promising for Western Canadian conditions.

The use of these spray materials have been confined largely to the control of weeds in the growing crop. Such weeds as the various mustards, stinkweed and the ragweeds have been the ones most effectively combatted. The reason for this is that the leaves of these weeds have a rough surface to which the spray material sticks while the leaves of the cereal grains have smooth surfaces which does not hold the spray material and hence they escape injury.

Some annual weeds, for example Lamb's Quarters, are quite easily killed in the younger stages but later on in their development, the construction of the leaf is so altered that much less damage is done by the spray material.

CHEMICALS TO USE

A—Copper Sulphate and Iron Sulphate

Both of these chemicals have been used fairly extensively in earlier as well as recent years. Practically all of the experimenters agree that the copper sulphate has been much more satisfactory than the iron sulphate. Because of this fact we will confine our discussion in this pamphlet to the use of the copper salt.

The copper sulphate dissolves rather slowly, but may be handled satisfactorily by placing the crystals in a strainer and pouring all the water to be used for the solution through them. This is a method frequently followed in making up the well known "Bordeaux" solution.

the speed of dissolving may be hastened by using hot instead of cold water.

Another method is to prepare a strong stock solution of the copper sulphate by suspending a fairly large quantity of the crystals, enclosed in a sask, in a barrel of water. Heated thus for ten or twelve hours the crystals will be entirely dissolved. The stock solution is then diluted to the required degree.

The rate of application most generally recommended is a 3% solution by weight. As a gallon of water weighs ten pounds there should not be any difficulty in figuring the correct amount to use.

Copper sulphate corrodes metals, consequently should be stored in wooden containers and any spraying apparatus should be thoroughly rinsed out after being used.

B—Sulphuric Acid

Sulphuric acid can be obtained quite readily and cheaply in Western Canada because if its occurrence as a by-product of the smelting industry. For this reason and that the acid has proven satisfactory as a spray for certain annual weeds, it offers a reasonable means of getting rid of some of our most undesirable annual weeds occurring in the growing crop.

Unfortunately sulphuric acid is not a nice product to handle as it burns flesh and clothing with which it comes in contact. This can be avoided by care in handling and the use of rubber coats

coupled with an application of a light grease to the hands and face of the person handling the spray material.

To avoid splashing always pour the acid into the water, never pour the water into the acid.

The rate of application that has been found satisfactory with sulphuric acid is 100 gallons to the acre of a 7% solution by weight. Crude sulphuric weighs approximately 1.8 times as much as water. This factor can be used to determine the quantity of acid to use if one wishes to measure the liquid instead of weighing it. As sulphuric acid is usually sold by weight, it is frequently easier to use weights than measures for making up the spray mixtures.

HOW TO SPRAY

Lead lined sprayers are available in different sizes, from the knapsack sprayer which is carried on the back to the large power sprayer covering around twenty feet at a time. As both the acid and the copper sulphate corrode the ordinary metals it is much safer to use a sprayer specially designed for the handling of such material.

In any case it is wise to rinse thoroughly after using all sprayers and other utensils used in handling spraying materials.

A fine spray should be used as this covers the leaves of the weeds more effectively than would a coarse spray.

A good supply of water is a very necessary part of the programme. It is well to have a large tank full hauled to a central location so that the least possible time is lost in the spraying operations.

WHEN TO APPLY THE SPRAY

The three to four leaf stage of the cereal appears to be the most desirable stage of growth at which to apply the chemical sprays. The cereals always suffer to some extent by the spraying, but when crops are treated before they are in the shot blade stage the injury is small and recovery quite rapid. Of course it is necessary that the weeds be well started before spraying. However, the smaller the weeds are when sprayed the more thorough is the killing.

Wheat and oats appear to be least affected by the spray materials but other types of cereal crops may be safely treated.

RESULTS OF SPRAYING

Where the weeds in the growing crop are plentiful and spraying is done at the proper stage of development of the crop and weed, the result is usually a more than sufficient increase in yield to pay the spraying costs. Moreover there are millions less weed seeds per acre at the end of the growing season.

The results obtained from a field of Reward wheat in the Swan River Valley were as follows: The wheat was in the advanced shot blade stage and was very heavily infested with common mustard in full bloom at the time of treatment. In this instance

the object was to determine the effect of the spraying on the setting of mustard seed.

The result indicated a very appreciable lowering in the total weight and total number of weeds and weed seeds per acre, but unfortunately around 15% less grain per acre was harvested.

A nearby area where barley was at the proper stage of development for treatment, but heavily infested with mustard, was also sprayed. In this instance, while 12.6% less straw was harvested the grain yielded 12.4% more. There was in addition a decrease of 89.7% in the weeds, and of 79.2% in weed seeds harvested. This experiment bears out the desirability of spraying at the proper time if profitable increase in yields are to be expected. If one is willing to sacrifice yield to some extent even late spraying will undoubtedly lessen to a marked degree the numbers of weed seeds harvested.

CONTROLLING PERENNIAL WEEDS BY MEANS OF CHEMICALS

The use of chemicals in the control of perennial weeds is quite different from the treatment of annuals. In the instance of perennial weeds the object is not only to kill the top growth but to destroy the root system as well.

Almost without exception the control of such weeds by the chemicals at present available has been too expensive to warrant its use on anything but smaller patches. The truth of this statement can readily be appreciated when it is realized that it would cost over seventy dollars to treat an acre with any of the most satisfactory chemicals now on the market.

WHAT CHEMICAL TO USE

The most satisfactory of the chemicals that we have tested thoroughly to date have been those consisting either wholly or in part of sodium chlorate. The pure sodium chlorate can be secured from most companies handling chemicals in large quantities. Chlorate containing weed exterminators as Atlacide can be secured from special companies.

New chemical mixtures are being put on the market quite frequently and some of these may prove quite satisfactory for the control of specific weeds.

Because of the efficiency of the sodium chlorate we will confine our recommendations to the use of this chemical alone. Special weed killers usually carry the manufacturer's recommendations as to rates of application and other necessary information.

WEEDS THAT CAN BE TREATED

Sodium chlorate has been found satisfactory for practically all of our worst perennial weeds. We have successfully controlled such weeds as Perennial Sow Thistle, Canada Thistle, Leafy Spurge, Hoary Cress, Poverty Weed and Couch Grass.

Again we wish to state that the profitable place to use such sprays is on small patches of the weeds that are just beginning to appear in any field or locality.

Sodium chlorate and chemical mixtures containing appreciable quantities of it, sterilize the soil so that no growth at all occurs for a period from a few months to as long as two years in some heavy soils. However, in no case is the effect permanent.

In this connection it has a place for use on roadways and other areas where one wishes to destroy all plant growth.

WHEN TO APPLY THE SPRAY

As far as the Prairie Provinces are concerned early spring treatments have not been as satisfactory as treatments made during the vigorous growing period of the plants. Usually this is just previous to or during the early flowering stage.

On the heavier soil types one treatment at the time mentioned is usually sufficient. On lighter types of soil where the effect of the chemical disappears much more rapidly it may be necessary to give a second treatment within two or three months after the first.

The full influence of the chemical may not be apparent until the spring following treatment.

In a few instances it has been necessary to repeat the treatment during the second season on a few surviving plants, but usually the killing is complete.

THE RATE AND METHOD OF APPLICATION

Two pounds per hundred square feet is usually sufficient to kill any of the weeds mentioned in this pamphlet.

Sodium chlorate comes in powder form and may be dusted on or dissolved in water and put on with a hand sprayer or a sprinkling can. Where sprinkling is followed a satisfactory practice is to dissolve the two pounds of sodium chlorate in two gallons of water and spray this evenly on the 100 square feet.

Evenness of application of either the powder or spray is very important if a thorough job is to be done.

PRECAUTIONS

Sodium chlorate and weed killers containing this chemical all possess a fire hazard to a greater or less degree. As a consequence the following precautions are advised.

1. Keep the clothing dry if possible.
2. If clothing becomes wet with the spraying solution wash them as soon as possible, in any event before the material has a chance to dry.
3. Do not allow the material to spill on wood, hay, straw, etc.
4. Always store the material in tightly covered containers.

Some weed killers, as Atlacide, are considerably less inflammable than the pure sodium chlorate.

FERTILIZERS AS WEED KILLERS

By their stimulating effect on plant growth fertilizers are a great help in enabling the ordinary crop plants to compete successfully with associated weeds. Our experiments have indicated a very marked reduction in the weight of harvested weeds and in the number of weed seeds per acre, where fertilizers have been used in the proper manner, with our cereal crops.

SUMMARY

1. The use of chemical weed killers is only justified where cultivation cannot be properly done, or where it has proven ineffective.

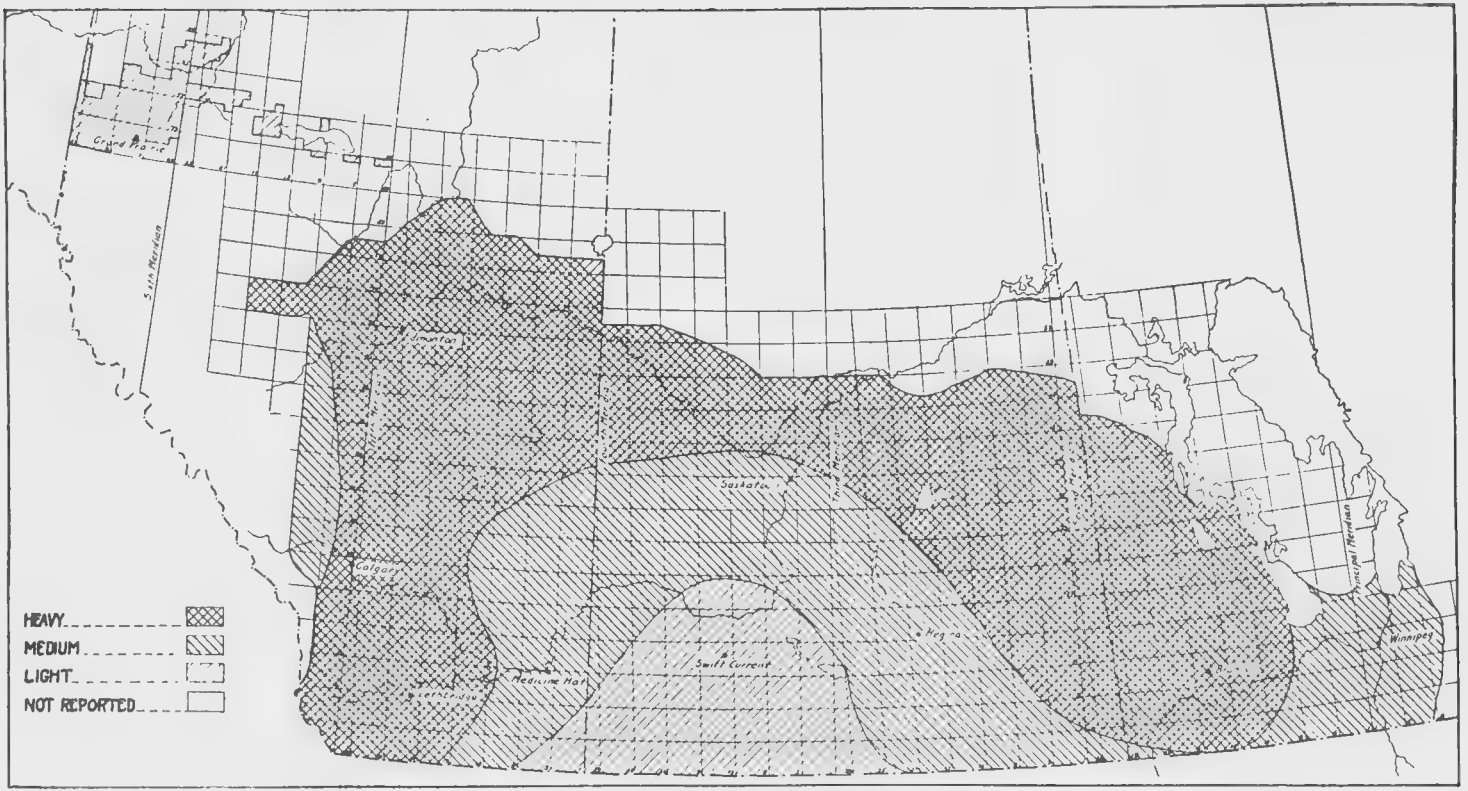
2. Some annual weeds can be successfully and profitably controlled in the growing crops.

3. The profitable use of chemical for the control of perennial weeds is confined almost entirely to the treatment of rather small patches.

4. Fertilizers, properly applied, are a material aid in lessening the weed menace in the common cereal crops.

WILD OATS

Wild Oats Showing Some of Their Common Characteristics



Distribution and prevalence of Wild Oats in Alberta, Saskatchewan and Manitoba, 1931.

WILD OATS

The most widespread weed found in the grain fields of Western Canada is the Wild Oat (Avena fatua). This weed has most of the characteristics of its close relative the cultivated oat, and due to this fact eradication methods are made more difficult for the farmer.

The heaviest infestations of Wild Oats are found in those areas which are not usually deficient in moisture as is shown in the foregoing map, taken from "Report No. 26, National Research Council."

THE PLANT

Wild Oats resemble the cultivated oat in most respects. However, they have certain characteristics which make them a troublesome weed. The chief outward difference is that the Wild Oat has a long twisted awn and a sucker mouth base, which makes identification easy. It differs also from the cultivated oat in its method of germination. Little trouble is experienced in getting the seed of the cultivated oat to germinate at any time after the plant is mature, the seed of the Wild Oat on the other hand may remain dormant for a number of months, and cultural treatment aimed at eradication has to take this factor into consideration.

While the existence of numerous varieties of the cultivated oat is an accepted fact, Wild Oats are thought of as all belonging to a common type. Such is not the case, as many different kinds of Wild Oats are found possessing not only different growth types, but also different soil and moisture requirements.

FALSE WILD OATS

False Wild Oats, while usually confused with the genuine types, have certain well defined points of distinction. For example, the true Wild Oats always have awns on both the primary and the secondary kernels, while the False Wild Oats may have awns on the primary kernel only. Also in the False Wild Oats a wider variation is found in the color of the kernel and in the degree of delayed germination. The size of the awn and the extent of the hairiness of the base of the kernel is quite appreciably less in the case of the False Wild Oat.

WHERE DID IT COME FROM ?

In common with many other bad weeds the place of origin of Wild Oats is recorded as Europe. It is assumed to have been imported with early shipments of cultivated oats.

MEANS OF SPREADING

Seed drill surveys conducted in the Western Provinces, through a period of years indicate that Wild Oats are the chief offenders as far as impurities in seed grain are concerned. This

establishes the threshed grain as the most common means of spreading Wild Oats. However, it may be spread by improperly cleaned threshing machines and hay balers, feed stuffs, and manure.

The seed of the Wild Oat ripens at the same time or a little earlier than that of the cultivated oat, and shells readily when ripe, reinfecting the field. It is almost impossible to cure a crop of cultivated oats containing Wild Oats without leaving the majority of the wild type seeds on the ground.

HOW WILD OATS ARE HARMFUL

By occupying the place of crop plants on the land.

By taking food, moisture and light needed by the crop.

By reducing the value of the crop.

By increasing costs due to increased cultivation, frequency of cultivation and special equipment.

PREVENTION AND CONTROL

In common with most of our worst annual weed plants, the Wild Oat depends mainly on its seed to maintain or increase its stand. Because of this fact the elimination of seed setting and distribution is the basis of all measures of prevention and control.

If one has been fortunate enough to have escaped thus far without having Wild Oats to contend with, the problem becomes one of continued watchfulness to keep this weed off the farm. In this instance all incoming seed and feed should be carefully examined before being used. If there is any possibility of Wild Oats being present, the grain should be thoroughly cleaned. The ripe seeds of Wild Oats can pass through the digestive tract of an animal and still retain their ability to grow. Hence it is desirable to grind contaminated grain before feeding, or to allow the manure to rot for a sufficient length of time to kill the seed. Well rotted manure is usually safe to use.

On the majority of farms Wild Oats are already present. However this should not constitute a reason for continuing to sow them each year. The chief difficulty is in making a satisfactory separation of the Wild Oats from the various kinds of grain in which they are found. Even with the ordinary type of mill, found on most farms, the Wild Oat content of infested seed can be greatly reduced. In such cases it is necessary to try out various combinations of screens, and various amounts of wind to arrive at the most efficient one for the particular type of seed being cleaned. Where Wild Oats are to be removed from wheat, the various disc machines and special kickers have proven fairly satisfactory. Probably the most efficient types of machines for the separation of Wild Oats from the seed of cultivated oat varieties are the so-called "carpet cleaners." Although slow in their operation these machines make a good separation if used on grain that has only been through the threshing machine. Where other

cleaners have been used previous to the carpet cleaner, a good many of the hairs have been removed from the base of the Wild Oat seed and consequently such seed does not stick to the carpet to the same extent as uncleaned seed.

A much greater proportion of Wild Oats might be removed from all kinds of cultivated cereal grains by a more careful adjustment of the threshing machine and a wiser choice of screens. The efficient use of recleaners in connection with the threshing machine still further reduces the Wild Oat content of the harvested product.

CONTROL

Because of the fact the Wild Oat depends on its seed for its continued existence, any control measures must have as their object the prevention of seed setting. It is extremely difficult to kill the seed itself in the ground, consequently the basis of control must be inducing the seed to germinate and killing the growing plant at some stage before a new crop of seed is matured.

Growers have attempted to kill the seed in the ground by deep plowing. Experimental evidence in this connection has presented proof that seed of Wild Oats can emerge from depths of 6 to 12 inches. In drier soils it has frequently been observed that a thicker stand of Wild Oats is secured from seeds buried 6 to 8 inches deep than those nearer the surface. On soil more plentifully supplied with moisture, the most complete germination was secured at shallower depths. Thus we see that the destruction of Wild Oat seeds by deep plowing does not offer much hope.

One of the chief difficulties in securing control by killing the growing plant lies in the fact that the seed does not all germinate at the same time. When sufficient moisture is present, 25 to 30 percent of the seeds may germinate in the fall that they mature. The remaining seed will usually germinate the following spring. However, under extremely dry conditions some seeds may not germinate for long periods. Seeds have been known to live in the soil as long as three years after ripening.

Fall germination may be appreciably increased by a shallow cultivation of the land, as soon as possible after harvest. Wild Oat seeds thus induced to grow are invariably killed during the winter. This is one of the easiest means of reducing the infestation of Wild Oats. Of course other annual weeds are also destroyed at the same time. The following three methods of summer control are suggested:

A. The Bare Fallow Method.

The success of this method depends on the destruction of the young growing Wild Oat plants by cutting them off. Unfortunately Wild Oat seedlings cannot be readily destroyed at all stages of maturity. It has been found that when plowed down or cut off by cultivation before they have reached the four leaf stage,

the young Wild Oat plants are able to continue growth from the nodes which are buried sufficiently to prevent them from drying out. It is possible therefore to actually increase rather than decrease the number of Wild Oats on a given area by cultivation too early, especially if soil moisture favors growth. Cultivation at later stages of development is much more effective. The delaying of cultivation till after heading is not to be recommended, as some seeds may have developed sufficiently to grow.

The difficulty in controlling Wild Oats by delayed cultivation is evident when such plants occur in fields also infested with perennial sow thistle, or other types of perennial weeds which require black summerfallow for their control. Under such circumstances it is extremely difficult to secure control of both types of weeds in one season. A better plan would appear to be to control as thoroughly as possible one type of weed, and depend on later efforts to complete the control of the second type.

B. Green Feed Method.

One of the most effective and economical methods of controlling Wild Oats is by seeding infested areas with a crop which is to be harvested for green feed. For early season seeding, cultivated oats seeded rather heavy are most desirable because of their habit of growth and high feeding value. For later planting the millets or similar crops can be used to good advantage. In all cases the crop must be harvested as soon as the first sign of heading is observed in the Wild Oats. It is absolutely necessary to watch the growing crop very closely to avoid reseeding of Wild Oat plants by allowing them to develop beyond the stage mentioned.

Not many Wild Oat seeds remain alive in the ground after the growing of a crop of green feed. This method of control not only permits of the elimination of most of the Wild Oats, but also checks the spread of many other weeds which develop with the crop. At the same time revenue is derived from the land.

C. Rotation Method.

Ordinary rotations where grain alone is used in successive planting are not effective in controlling Wild Oats. To secure control it is necessary to include in the rotation a hay or pasture crop. Where hay is used the first year, and the area pastured the second year, satisfactory control has been secured. All ordinary hay crops, when cut at the proper time, remove the Wild Oats before they have had an opportunity to develop seed. In the pasture year any Wild Oats that appear are readily consumed by all kinds of livestock, thus preventing seed setting. In the event of an insufficient number of animals being pastured on the area to keep it grazed closely, it may be necessary to use the mower to prevent any remaining plants from going to seed. Under such circumstances it is necessary to cut off the Wild Oats as soon as the first signs of heading are observed.

A FEW GENERAL CONSIDERATIONS

1. Wild Oats are a widespread and very serious weed, causing large annual losses to the farmers of Western Canada.

2. The chief means of spread is by the seed, hence the chief means of control lies in the prevention of seed formation.

3. The seeding of Wild Oats with the seed of cultivated crops can be greatly lessened by a more thorough cleaning of the seed with suitable mills, including a careful adjustment of the threshing machine.

4. Where feed containing Wild Oat seeds is fed to animals it should either be ground or the manure from the animals allowed to rot for a sufficient length of time to destroy the germination of the seeds.

5. Control by cultivation is more effective when done after the Wild Oat plant has reached the four leaf stage of development.

6. The control of Wild Oats by the growing of green feed crops is a cheap and effective method where the crop is cut in sufficient time to prevent seeding.

7. The use of a rotation containing a hay and pasture crop greatly reduces the number of Wild Oats on any infested farm.

Leafy Spurge Control

LEAFY SPURGE

THE PLANT

Leafy Spurge (Euphorbia Esula L.) is a long lived perennial herb, somewhat woody at the base and containing a milky sap. It may grow from 12 to 36 inches high, and when it is young it greatly resembles the young flax plant. Both the roots and the seed are used in the propagation of this weed. The color of the plant is unusual. The leaves are a bluish green, even at the height of the growing period. In the fall the leaves turn a reddish colour. The inconspicuous flowers are coloured a greenish yellow. We do not usually find this plant solitary but in patches, as it has usually gained a foothold on the land before it is noticed.

The plant may be recognized early in the spring by the pinkish buds that are formed and which appear above the ground. In Manitoba these buds may be seen in an average season about the 15th of April. By the middle of May the plant has usually reached a height of about 14 inches, and is just coming into flower. The seed is in a three chambered capsule, and when this capsule is ripe the seeds are shot from the plant, thus aiding in its local distribution. The flowers are in a panicle-like arrangement on the top of the stalk.

The seed is oval in shape and of a grey colour, usually tinged with purple. The leaves are long and narrow, entire and smooth to the touch.

The root is by far the most prominent part of this plant. It may extend into the Red River clay soil to a depth of 6-8 feet, or to the water table. Besides the vertical roots, numerous lateral roots are formed, from which arise many buds which produce new plants. The root stores a large amount of food material which enables the plant to survive long periods of adverse conditions. It is this fact that makes the eradication of this pest such an undertaking. The roots near the surface are brown in colour and very woody in texture. Buds are formed on both the lateral roots and the vertical ones. The buds are usually found in the top sixteen inches of the soil and their number per running inch is amazing. This fact explains the reason that the plant can so easily be transplanted from one place to another and readily survive. The numerous roots, both coarse and fine, occupy a great deal of space in the soil and make it very difficult to grow a cultivated crop on infested areas. The type of root system varies with the soil in which it is growing. In the lighter soil areas we find that the roots penetrate nearly twice as fast as in the heavy clay areas. In the later case, however, much more branching is found.

Cattle appear to avoid the plant in pastures, but the claim that it is poisonous does not seem to be justified by observations in the infested areas of Manitoba.

Young Leafy Spurge Buds Growing From the Previous Year's Root. This Picture Also Shows the Lateral Type of Spreading Roots.

DISTRIBUTION

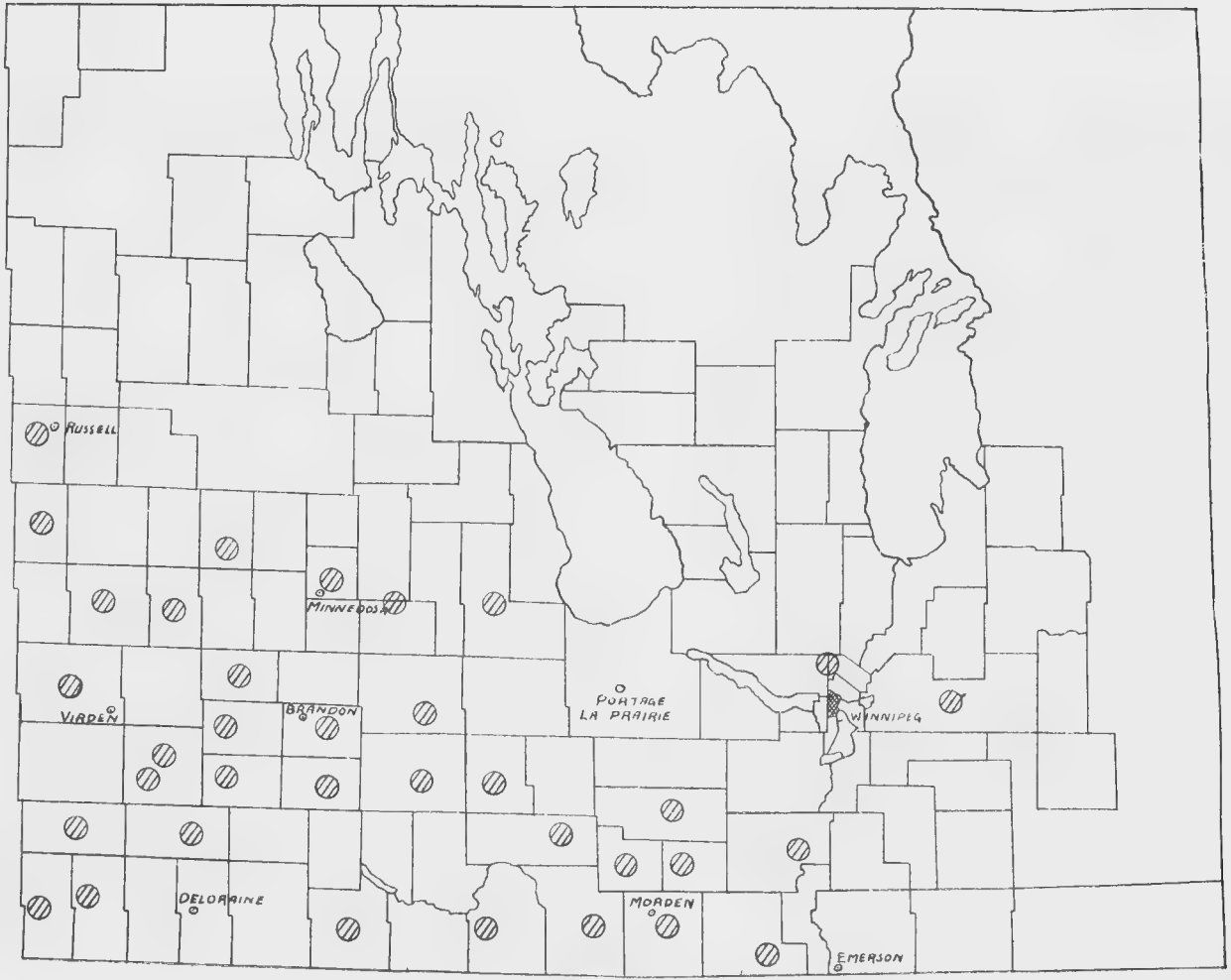
Leafy Spurge has been known to exist in the United States for around a hundred years. It was early recognized as a weed that was likely to become troublesome, and it has fully lived up to these expectations. The chief areas of infestation in the United States seem to be the Dakotas and Minnesota. In Manitoba this weed has spread as far north as Russel. It is found from the western boundary of the province to the Red River valley on the east. The chief places from which Leafy Spurge infestations have been reported are shown in the accompanying map, prepared in collaboration with the Provincial Department of Agriculture.

WHERE DID IT COME FROM ?

Although claimed to be a native of Europe, Leafy Spurge was likely brought into Manitoba from the neighboring states to the south. Doubtless the first infestations were the result of impurities in seed. Once the plant becomes established its propagation proceeds rather rapidly.

HOW DOES IT SPREAD ?

Leafy Spurge is able to reproduce itself either from root sections or from seed. The roots are the chief source of spreading, as the seedlings are weak and few of them survive. Sections of the root are cut or broken off when infested areas are cultivated or plowed. These pieces soon establish themselves and spread the outbreak. Seed may also be instrumental in spreading the in-



Districts where Leafy Spurg[illegible] been found in Manitoba.

festation. The seed in the capsules is capable of being shot 12 feet or more. In common with other types of weed seeds they are readily spread from farm to farm by the interchange of seed and feed.

HOW IT DOES DAMAGE

By occupying the place of crop plants on the land.

By taking food, light and moisture that is needed by the plant.

By greatly increasing the necessity of frequent cultivation.

By increasing the cost of power to work the land.

Heavy infestations make the growing of a paying crop impossible.

HOW LEAFY SPURGE IS BEST CONTROLLED

Seed from infested areas should be thoroughly cleaned before it is sown. Care should be taken also that any equipment, taken from farm to farm be clean. Small sections of the root may stick to the cultivator teeth and eventually gain a foothold on clean land. Hay and feed should not be transferred from the weedy farm.

When first noticed, the patch should be isolated and special treatment applied. If the patch is relatively small, chemical means can be used satisfactorily in eradicating the weed. The most effective chemical that we have experimented with for the killing of deep rooted perennials is Sodium Chlorate, or mixtures containing this chemical, such as Atlacide. The chemical may be applied with a watering can, but an apparatus giving a finer spray is more satisfactory. The usual rate for perennials is one pound of the chemical dissolved in two gallons of water. In applying this spray, all the foliage should be covered. Sodium Chlorate needs to be handled carefully, due to the fact that it is inflammable. Clothes on which the spray has fallen should be washed after using, and care taken to see that none of the spray falls on the face or the hands, as it is likely to cause a burn. This chemical causes temporary soil sterilization, but for the small areas usually treated, this factor is not as important as getting rid of the weed.

For larger areas of Leafy Spurge cultural treatment seems to offer the best possibility. If no cultural treatment is applied and no attempt made in controlling this weed the land may eventually have to be abandoned. This has been the case in some of the heavily infested areas. One year's summerfallow has been tried by some farmers with disappointing results. This is due to the fact that the stored food in the roots of the weed outlasts the adverse growing conditions caused by summerfallow. Two year's black summerfallow seems to be necessary for the control of this deep rooted perennial. In the lighter soil areas the danger of soil drifting under such treatment necessitates the adoption of strip control. If sections about two rods wide are treated, leaving approximately equal areas untouched, soil drifting will be reduced to a minimum.

Control by a single year's black fallow, followed the second year by a cereal crop heavily seeded has been suggested. The writers checked this method, using barley seeded at over four bushels per acre, but even with this excellent competitive crop, the Leafy Spurge was able to survive sufficiently to reinfest the whole area treated.

The best implement for the cultural treatment of Leafy Spurge is the rod weeder, because of the fact that it cuts off practically all vegetation. The duckfoot cultivator can be successfully used if the teeth are kept sharp and overlap sufficient to cut off all of the green growth. The spring-tooth harrow is not to be recommended. The important measure in the control of any of the perennial weeds is to keep all the green growth cut off. This prevents the production and storing of plant food. If this is done the plant eventually starves. In the control of Leafy Spurge do not attempt to treat too large an area. Proper summerfallow may necessitate cultivation every week or ten days through considerable periods of time. Neglect in this regard renders previous work useless.

A FEW GENERAL CONSIDERATIONS

1. Small patches of Leafy Spurge may be eradicated by the use of Sodium Chlorate or sprays containing this chemical.

2. Large infested areas require two years' black summerfallow for effective control.

3. Strip control in sections around two rods wide will do much to prevent soil drifting on the lighter types of soil.

4. Do not cultivate through small patches, as a new plant may develop from very small pieces of the root.

5. Feed, seed and hay from infested areas should not be taken from such areas to those that are clean.

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